APPENDIX E

DIRECT CONTACT

This portion of Appendix E explains the methods Montana Department of Environmental Quality (DEQ) used to develop direct contact risk-based screening levels (RBSLs) for Tier 1 of the risk-based corrective action (RBCA) process. The appendix is made up of tables and spreadsheets used to develop the RBSLs. The following is a brief explanation of these tables and spreadsheets. Data sources are provided in the spreadsheets and a reference list is provided at the end of the appendix. DEQ chose conservative parameters to develop RBSLs applicable to a wide variety of sites.

Table 1 provides a compilation of the chemical specific information used to develop the RBSLs and the actual direct contact RBSLs calculated for each compound.

The Volatilization Factors spreadsheet was used to calculate volatilization factor for the volatile analytes using the method provided in the Environmental Protection Agency (EPA) Soil Screening Guidance: Technical Background Document (EPA, May 1996). Data sources are provided at the end of the spreadsheets.

The Age-Adjusted Factors spreadsheet was used to calculate age-adjusted factors for the soil ingestion, inhalation, and dermal contact exposure routes using the method provided in the EPA Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part B, Developing Risk-based Preliminary Remediation Goals) (EPA, December 1991) and the EPA Region IX Preliminary Remediation Goals (EPAIX, October 2002).

The Residential Scenario: Carcinogens spreadsheet was used to calculate RBSLs for residential exposure to carcinogens using the methods provided in EPA, December 1991. These RBSLs are based on a target risk of $1X10^{-6}$, providing some assurance that overall site risks will not exceed $1X10^{-5}$, and are applied to the top 2 feet of soil at sites where the current and reasonably expected future usage is residential.

The Residential Scenario: Non-carcinogens spreadsheet was used to calculate RBSLs for residential exposure to non-carcinogens using the methods provided in EPA, December 1991, EPA Region IX, October 2002, the Massachusetts Department of Environmental Protection (MADEP) Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of the MADEP VPH/EPH Approach, Final Policy (October 31, 2002) and the MADEP May 2002 Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH Methodology. (Volatile Petroleum Hydrocarbons = VPH and Extractable Petroleum Hydrocarbons = EPH). These RBSLs are based on a target hazard quotient of 0.125 for each compound. There are eight possible non-carcinogens, including the non-target fractions, present in either gasoline or diesel. Therefore, a hazard quotient of 0.125 provides some assurance that the overall hazard index for a site will not exceed 1. These RBSLs are applied to the top 2 feet of soil at sites where the current and reasonably expected future usage is residential.

The Commercial Scenario: Carcinogens spreadsheet was used to calculate RBSLs for a commercial worker's exposure to carcinogens using the methods provided in EPA, December 1991. These RBSLs are based on a target risk of $1X10^{-6}$, providing some assurance that overall site risks will not exceed $1X10^{-5}$, and are applied to the top 2 feet of soil at sites where the current and reasonably expected future usage is commercial or industrial.

The Commercial Scenario: Non-carcinogens spreadsheet was used to calculate RBSLs for a commercial worker's exposure to non-carcinogens using the methods provided in EPA, December 1991 MADEP, October 2002, and MADEP, May 2002. These RBSLs are based on a target hazard quotient of 0.125 for each compound. There are eight possible non-carcinogens, including the non-target fractions, present in either gasoline or diesel. Therefore, a hazard quotient of 0.125 provides some assurance that the overall hazard index for a site will not exceed 1. The RBSLs are applied to the top 2 feet of soil at sites where the current and reasonably expected future usage is commercial or industrial.

The Excavation Scenario: Carcinogens spreadsheet was used to calculate RBSLs for an excavator's exposure to carcinogens using the methods provided in EPA, December 1991. These RBSLs are based on a target risk of $1X10^{-6}$, providing some assurance that overall site risks will not exceed $1X10^{-5}$ and are applied to soil greater than 2 feet below the ground surface at all sites where there is a potential for utility installation, pipe repair, or other excavation in the future.

The Excavation Scenario: Non-carcinogens spreadsheet was used to calculate RBSLs for a excavator's exposure to non-carcinogens using the methods provided in EPA, December 1991 and MADEP, October 2002 and MADEP, May 2002. These RBSLs are based on a target hazard quotient of 0.125 for each compound. There are eight possible non-carcinogens, including the non-target fractions, present in either gasoline or diesel. Therefore, a hazard quotient of 0.125 provides some assurance that the overall hazard index for a site will not exceed 1. The RBSLs may be applied to soil greater than 2 feet below the ground surface at all sites where there is a potential for utility installation, pipe repair, or other excavation in the future.

The Water Quality Guidelines for Non-Target Analytes spreadsheet was used to calculate RBSLs for non-target analytes in water using the methods provided in the EPA Drinking Water Regulations and Health Advisories (EPA, October 1996) and MADEP, October 2002 and MADEP, May 2002.

REFERENCES

Environmental Protection Agency (EPA), December 1989. Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual Part A.

EPA, December 1991. Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals).

EPA, March 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons.

EPA, May 1996. Soil Screening Guidance: Technical Background Document.

EPA, October 1996. Drinking Water Regulations and Health Advisories.

EPA, August 1997. Exposure Factors Handbook Volume I General Factors.

EPA Region III, December 1995. Assessing Dermal Exposure from Soil.

EPA Region IX, October 2003. Preliminary Remediation Goals.

IRIS, September 2003. EPA's Integrated Risk Information System.

Massachusetts Department of Environmental Protection (MADEP), October 2002. Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of MADEP VPH/EPH Approach Public Comment Draft.

Massachusetts Department of Environmental Protection (MADEP), May 2002. Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH Methodology.

Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG), July 1997. Selection of Representative TPH Fractions Based on Fate and Transport Considerations.

TABLE 1: Chemicals of Potential Concern Which Will Be Evaluated for Possible Inclusion in Tier 1							
Compound	**VF (m^3/kg)**	**Carc.**	**RfDo mg/kg-d/ SFo kg-d/mg**	**RfDi mg/kg-d/ SFi kg-d/mg**	**Res. mg/kg**	**Comm. mg/kg**	**Exc. mg/kg**
For Gasoline							
C5-C8 Aliphatics	1,419	n	0.06	0.057	13	51	103
C9-C12 Aliphatics	8,563	n	0.1	0.057	72	304	605
C9-C10 Aromatics	13,094	n	0.03	0.0057	12	47	94
MTBE	6,018	n	0.033	0.857	231	2,321	3,670
Benzene	3,133	c	0.055	0.027	0.66	1.6	81
Toluene	3,971	n	0.2	0.114	71	287	576
Ethylbenzene	4,601	n	0.1	0.286	175	812	1,586
Xylenes	4,302	n	0.2	0.029	20	80	160
Naphthalene	NA	n	0.02	0.00086	195	4,087	4,578
For Diesel and Heavy Compounds							
C9-C18 Aliphatics	17,605	n	0.1	0.057	135	607	1,196
C19-C36 Aliphatics	NA	n	2	NA	19,552	411,313	459,445
C11-C22 Aromatics	78,193	n	0.03	0.0057	66	278	554
Benz(a)anthracene	NA	c	0.73	NA	0.82	6.3	176
Benzo(a)pyrene	NA	c	7.3	NA	0.082	0.63	18
Benzo(b)fluoranthene	NA	c	0.73	NA	0.82	6.3	176
Benzo(k)fluoranthene	NA	c	0.073	NA	8.2	63	1,762
Dibenzo(a,h)anthracene	NA	c	7.3	NA	0.082	0.63	18
Anthracene	NA	n	0.3	NA	2,933	61,697	68,917
Acenaphthene	NA	n	0.06	NA	587	12,339	13,783
Fluoranthene	NA	n	0.04	NA	391	8,226	9,189
Fluorene	NA	n	0.04	NA	391	8,226	9,189
Naphthalene	NA	n	0.02	0.00086	195	4,087	4,578
Pyrene	NA	n	0.03	NA	293	6,170	6,892
Chrysene	NA	c	0.0073	NA	82	631	17,623
Indeno(1,2,3-cd)pyrene	NA	c	0.73	NA	0.82	6.3	176

PEF = 1.10E+09 m^3/kg (EPA, May 1996)